Journal of Electrostatics xxx (2010) 1

Contents lists available at ScienceDirect

Journal of Electrostatics

journal homepage: www.elsevier.com/locate/elstat

Letter to the Editor: Assessing the suitability of garments for use in electrostatically sensitive work areas

A formal Standard document has recently been published by the International Electrotechnical Commission IEC 61340-4-9 "Electrostatics–Standard test methods for specific applications–garments". This document states that the suitability of garments for applications in areas where static electricity may create risks or problems is to be judged solely on the basis of resistivity measurement. This is not an adequate approach for the following reasons:

In clean work areas where static electricity may present risks or problems people use over-garments that are basically a polyester fabric with conductive threads included to 'control' these risks. Examples are in the microelectronics and pharmaceutical industries. The aim of such static control measures is to limit the voltages that may arise on garment surfaces due to physical contact or rubbing actions with other surfaces. Such voltages will create electric fields and induce charge on any nearby static sensitive devices and/or systems as well as attract dust and debris.

Polyester fabric is, of itself, a very insulating material and when rubbed will easily become highly charged and will retain that charge for some time. The conductive threads are introduced as a fairly open grid or stripe pattern. The threads cover only a very small fraction of the surface area so their influence is very localized. This means that the surface of the material is very inhomogeneous from the electrostatic point of view and from the point of view of measurement of surface resistivity. (The non-homogeneous nature of cleanroom garment type fabrics is easy to spot visually – from the evident pattern of dark threads in a white or pale blue material. With other materials a non-homogeneous nature cannot so easily be recognised, visually or by simple measurement).

When the surface of such materials is contacted or rubbed the influence of the separated surface charge on items nearby will be very different for charge separated on areas of fabric between the threads compared to that of charge separated close to the threads. Some garment makers use conductive threads that have a surface conductivity, others use conductive threads where the conductivity is as a core of the thread and is sheathed with polyester. Fabrics that include threads with surface conductivity are likely to pass a standard surface resistivity test because the conductive components will be contacted by the electrodes used in the measurement. Those with core conductivity threads will fail.

Fabrics including either type of conductive thread may individually be judged by the companies that use them as electrostatically acceptable. This raises the question as to how the electrostatic characteristics should be assessed.

Studies have been made with inhabited cleanroom garments where surface charge has been created by short-term local tribocharging actions [1]. These studies showed clearly that the surface voltages created per unit of charge are comparable between fabrics with surface and with core conductive threads with similar thread patterns in the fabric. These studies also showed that for both surface and core conductive threads the main factor limiting the surface voltage is the spacing between the conductive threads. Resistivity is not a relevant parameter.

Appreciable voltages can be created on garments with large thread spacings that pass resistivity testing. Comparable voltage levels arise for the same amounts of charge for garments with core conductive threads that fail resistivity testing.

On the basis of such results it would be appropriate to look again at the objectives and suitability of test methods used to assess materials.

There are a number of test methods available and in commercial use for assessing the electrostatic suitability of garments, fabrics and other materials. Many of these do not achieve the objectives required. Those that rely on creating a surface potential by connection to a voltage source and then earthing this connection [2] are not appropriate because one cannot be sure of reliable charging of the fabric surface in the areas between the conductive threads. This is the area of the fabric where retained static charge will have the greatest influence on items nearby after the fabric has been charged in practice by contact or rubbing actions. Methods that rely on connecting a boundary to earth after tribo or corona charging the fabric are not appropriate – this is not the practical situation and the 'decay' observed will be dominated by the influence of the conductive components. The only suitable methods of testing are those where charge arises on the surface by tribocharging or by corona charging where the fabric is supported or used as in its practical application [3].

References

[1] J.N. Chubb, P. Holdstock, Tribocharging studies on inhabited cleanroom garments, J. Electrostatics 66 (2008) 531–537.
[2] US Federal Test Standard 101C Test Method 4046. EIA Interim Standard IS-5-A
[3] J.N. Chubb, Comments on methods for charge decay measurement, J. Electrostatics 62 (2004) 73–80.

John Norman Chubb*
Infostatic Ltd, 2 Monica Drive, Pittville, Cheltenham, Glos GL50 4NQ, United Kingdom
* Tel.: +44 1242 573454; +44 1242 573454.
E-mail address: jchubb@infostatic.co.uk

29 May 2010
Available online xxx

0304-3886/$ – see front matter
doi:10.1016/j.elstat.2010.06.002